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09/676,520	09/29/2000	Douglas R. Miller		2711

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EXAMINER	
ALI, SYED J	

ART UNIT	PAPER NUMBER
2127	3

DATE MAILED: 02/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/676,520	MILLER, DOUGLAS R.	
	Examiner	Art Unit	
	Syed J Ali	2127	

-- The MAILING DATE of this communication appears on th cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2000*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,5-16 and 23-27* is/are rejected.

7)☒ Claim(s) *2-4,17-22,28 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 3 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim, or amend the claim to place the claim in proper dependent form, or rewrite the claim in independent form.

Claim 3 recites a particular state transition of "between operational states of the computer system" that is already claimed in parent claim 2.

2. Claim 16 objected to because of the following informalities: The limitation of "taking additionally steps" should read "taking additional steps". Appropriate correction is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 6-8, 10-14, 16, 23-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bates et al. (USPN 6,378,124) (hereinafter Bates) in view of Browning et al. (USPN 6,006,247) (hereinafter Browning).

As per claim 1, Bates discloses a mechanism for a mutex in a computer system, comprising:

an identifier of the owner of the mutex (col. 7 lines 33-65, "A 'threads suspended' field 32*g* records threads held by the mutex for purpose such as displaying to the user and to test against the condition in field 32*f*").

an indicator of whether the mutex was acquired before or after a particular event occurred (col. 9 lines 15-48, "If in block 83 the thread encountering the synchronization control point is included in the synchronization condition, then a determination is made as to whether the synchronization condition is triggered for this synchronization control point"); and

a mutex handler responsive to the identifier and the indicator (col. 7 lines 33-65, "A 'mutex' field 32*d* is used to tie together multiple records in the break point table 32 when a plurality of synchronization control points are used. In addition, the mutex field 32*d* may contain information needed to interact with the mutex handler 19 in controlling the threads").

Browning discloses the following limitations not shown by Bates, specifically a computer system having at least one possible state transition (col. 4 line 62 - col. 5 line 40, "a thread originates at state 70 [TSIDL] and proceeds to state 74 [TSRUN], which represents the state of threads on global execution queue 40 waiting to run"), wherein the event is a state transition (col. 6 lines 36-56, "a thread is put to sleep [i.e., makes a state transition to state 76], if continued execution of the threads depends upon the occurrence of a specified event", wherein putting a thread to sleep is one possible state transition).

It would have been obvious to one of ordinary skill in the art to combine Bates with Browning since the thread synchronization method using synchronization control points

disclosed in Bates require the monitoring of other threads of execution, yet fails to specifically monitor the execution state of a thread. Specifically, Bates waits for a thread to reach another control point before resuming the thread requiring synchronization. Supposing that the other thread moves into a suspended or delayed execution state, the waiting thread may be subject to a prolonged period of waiting. By monitoring the execution state of the other threads, such conditions could be detected and handled accordingly, thereby eliminating or reducing "hang" or "deadlock" conditions.

As per claim 6, Bates discloses the mechanism of claim 1, wherein the indicator is a modification of the identifier (col. 9 lines 15-26, "If in block 83 the thread encountering the synchronization control point is included in the synchronization condition, then a determination is made as to whether the synchronization condition is triggered for this synchronization control point", wherein the indication as to whether or not the synchronization condition has been satisfied is based on the owning system object).

As per claim 7, Applicant discloses prior art that discloses the mechanism of claim 1, wherein the identifier identifies a processor (Abstract, "Existing mutex data structures include an identifier of the engine/processor...acquiring the mutex").

As per claim 8, Applicant discloses prior art that discloses the mechanism of claim 7, wherein the identifier is a processor ID value (page 4, "In general, all objects within an OS [or

any other software] need a unique identifier [ID}, which can be used to refer to the object in an efficient manner", "Processor [engine] objects are also assigned an ID").

As per claim 10, Bates discloses the mechanism of claim 1, wherein the mutex handler includes:

first mutex handling routines for use before the state transition (col. 9 lines 26-55, wherein if the synchronization condition, i.e., state transition, has occurred, the mutex handler routine performs a different function than if the condition had not yet been satisfied in accordance with Fig. 6 element 84); and

second mutex handling routines for use after the state transition (col. 9 lines 26-55, wherein if the synchronization condition, i.e., state transition, has occurred, the mutex handler routine performs a different function than if the condition had not yet been satisfied in accordance with Fig. 6 element 84).

As per claim 11, Bates discloses the mechanism of claim 1, wherein the mutex handler overrides the mutex if the mutex was acquired before the state transition (col. 9 lines 26-55, "if the synchronization condition was not triggered and thus the thread is to be suspended, then in block 91 the break point table is updated to reflect that the thread is being held. Then, the break point manager routine 48 updates the mutex handler to hold the thread"), and handles the mutex normally if the mutex was acquired after the state transition (col. 9 lines 26-55, "If the mutex is not set, the break point manager need only recommence program execution rather than interact with the mutex handler").

As per claim 12, Bates discloses a method for handling a mutex after an event in a computer system, comprising the steps of:

determining whether the mutex was acquired before or after the event (col. 9 lines 15-48, "If in block 83 the thread encountering the synchronization control point is included in the synchronization condition, then a determination is made as to whether the synchronization condition is triggered for this synchronization control point"); and

handling the mutex differently depending on whether the mutex was acquired before or after the event (col. 9 lines 26-55, wherein if the synchronization condition, i.e., state transition, has occurred, the mutex handler routine performs a different function than if the condition had not yet been satisfied in accordance with Fig. 6 element 84).

Browning discloses the following limitations not shown by Bates, specifically that the event is a state transition (col. 4 line 62 - col. 5 line 40, "a thread originates at state 70 [TSIDL] and proceeds to state 74 [TSRUN], which represents the state of threads on global execution queue 40 waiting to run").

It would have been obvious to one of ordinary skill in the art to combine Bates with Browning for reasons discussed above in reference to claim 1.

As per claim 13, Bates discloses the method of claim 12, wherein whether the mutex was acquired before or after the state transition is determined from a data structure of the mutex (col. 7 lines 33-42, "a data structure for a break point table 32 references in Figs. 1-2 is illustrated", wherein the break point table contains entries pertaining to each mutex).

As per claim 14, Bates discloses the method of claim 12, wherein the step of handling the mutex includes:

overriding the mutex if the mutex was acquired before the state transition (col. 9 lines 26-55, "if the synchronization condition was not triggered and thus the thread is to be suspended, then in block 91 the break point table is updated to reflect that the thread is being held. Then, the break point manager routine 48 updates the mutex handler to hold the thread"); and

handling the mutex normally if the mutex was acquired after the state transition (col. 9 lines 26-55, "If the mutex is not set, the break point manager need only recommence program execution rather than interact with the mutex handler").

As per claim 16, Bates discloses the method of claim 12, further including the step of:

taking additionally steps to terminate the owner of a mutex acquired before the state transition (col. 9 lines 49-55, "if the synchronization condition was not triggered and thus the thread is to be suspended, then in block 91 the break point table is updated to reflect that the thread is being held", wherein the suspension of the thread effectively terminates the execution of the thread on the processor until the synchronization condition has been satisfied).

As per claim 23, Bates discloses a computer program comprising computer program code means adapted to perform all the steps of the method of claim 12 when run on a computer (Fig. 1, wherein the method is implemented within a computer system, which runs computer program code).

As per claim 24, Bates discloses an article for handling a mutex, comprising:

a computer-readable signal-bearing medium (Fig. 1, wherein the method is implemented within a computer system, which transmits signals across devices using computer-readable mediums and associated signals); and

means in the medium for performing the steps of claim 12 (Fig. 1 wherein the method is implemented within a computer system, which contains means to perform any method steps that are associated with the computer system).

As per claim 25, Bates discloses an article for handling a mutex after an event in a computer system comprising:

a computer-readable signal-bearing medium (Fig. 1, wherein the method is implemented within a computer system, which transmits signals across devices using computer-readable mediums and associated signals);

means in the medium for determining whether the mutex was acquired before or after the event (col. 9 lines 15-48, "If in block 83 the thread encountering the synchronization control point is included in the synchronization condition, then a determination is made as to whether the synchronization condition is triggered for this synchronization control point"); and

means in the medium for handling the mutex differently depending on whether the mutex was acquired before or after the event (col. 9 lines 26-55, wherein if the synchronization condition, i.e., state transition, has occurred, the mutex handler routine performs a different function than if the condition had not yet been satisfied in accordance with Fig. 6 element 84).

Browning discloses the following limitations not shown by Bates, specifically that the event is a state transition (col. 4 line 62 - col. 5 line 40, "a thread originates at state 70 [TSIDL] and proceeds to state 74 [TSRUN], which represents the state of threads on global execution queue 40 waiting to run").

It would have been obvious to one of ordinary skill in the art to combine Bates with Browning for reasons discussed above in reference to claim 1.

As per claim 26, Bates discloses the article of claim 25, wherein the medium is a recordable data storage medium selected from the group consisting of magnetic, optical, biological and atomic data storage media (col. 6 lines 7-31, "Examples of signal bearing media such as volatile and nonvolatile memory devices, floppy and other removable disks, hard disk drives, optical disks [e.g., CD-ROM's, DVD's, etc.], among others").

As per claim 27, Bates discloses the article of claim 25, wherein the medium is a modulated carrier signal (col. 6 lines 7-31, "Examples of signal bearing media such as volatile and nonvolatile memory devices, floppy and other removable disks, hard disk drives, optical disks [e.g., CD-ROM's, DVD's, etc.], among others", wherein a modulated signal carrier is one type of signal bearing media and falls under the scope of the disclosure of Bates).

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bates in view of Browning in view of Mithal et al. (USPN 6,636,950) (hereinafter Mithal).

As per claim 5, Mithal discloses the following limitations not shown by the modified Bates, specifically the mechanism of claim 1, wherein the indicator and the identifier are combined and sized to be handled in a single atomic operation (col. 18 line 12 - col. 19 line 13, "Additional memory access instructions useful for synchronizing processes executing on different instruction processors 110 are used in conjunction with the instructions described in Section 2. These include mutex P and V instructions [wait and signal operations], a test-and-set instruction, and load-reserved and store-conditional instructions, all of which are executed as atomic operations by the memory system").

It would have been obvious to one of ordinary skill in the art to combine the modified Bates with Mithal since the use of atomic machine instructions ensures that an operation completes without interruption. The use of atomic operations within mutual exclusion and other synchronization mechanisms is commonplace since data dependencies require consistent states of threads of shared resources. Specifically, if a thread is accessing a shared resource and is then interrupted, a deadlock condition could arise. By ensuring that the resource is acquired through the use of an atomic operation, the shared resource would be in a known state before the thread is stopped.

6. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bates in view of Browning in view of Burrows et al. (USPN 6,662,364) (hereinafter Burrows).

As per claim 9, Burrows discloses the following limitations not shown by the modified Bates, specifically the mechanism of claim 1, wherein:

the identifier is a first value if the mutex is acquired before the state transition (col. 8 lines 23-55, "Usage of stack pointers as substitutes for thread identifiers presents special problems, however. For instance, the value of $SP(T_{assc}(M))$ varies with time, so comparisons between $SP(T_{req})$ and SP(M) may not agree when $SP(T_{assc}(M))$ has varied at some point after time t", wherein the identifier of the owner of the thread changes with time); and

the identifier is a second value if the mutex is acquired after the state transition (col. 8 lines 23-55, "Usage of stack pointers as substitutes for thread identifiers presents special problems, however. For instance, the value of $SP(T_{assc}(M))$ varies with time, so comparisons between $SP(T_{req})$ and SP(M) may not agree when $SP(T_{assc}(M))$ has varied at some point after time t", wherein the identifier of the owner of the thread changes with time).

It would have been obvious to one of ordinary skill in the art to combine the modified Bates with Burrows since potential changes that may occur to a shared resource during a state transition or other modification of the resource should be reflected within the resource's identifier. Burrows provides a way of modifying the identifier as a function of time, as the owner thread of the resource can change from moment to moment.

7. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bates in view of Browning in view of Franke et al. (USPN 6,243,788) (hereinafter Franke).

As per claim 15, Franke discloses the following limitations not shown by the modified Bates, specifically the method of claim 12, further including the step of:

voluntary termination by a thread (col. 8 lines 39-67, "The scheduling state is shared by all processors and access to it is appropriately coordinated using locks or other well known mechanisms. This is necessary because the scheduler code executes on every processor when either the currently running thread voluntarily yields the processor to another thread or when the time quantum of the thread currently running on this processor has expired").

It would have been obvious to one of ordinary skill in the art to combine the modified Bates with Franke since preemption or interruption of executing threads could result in deadlock conditions, where a thread being synchronized continues to wait for the thread that has been abnormally terminated. By requiring that the thread yields voluntarily, the thread is in a known state when it completes. Furthermore, Franke makes the state of the processor and the thread known across the system, such that other threads being synchronized are aware of their dependent thread's progress.

Bates discloses where the thread existed before the state transition (col. 8 line 60 - col. 9 line 14, "a determination is made as to whether the synchronization condition for this control point includes the specific thread that hit the control point", wherein the thread exists before the test for the synchronization condition, which has been established as a state transition when taken in combination with Browning as discussed above), and where the thread accesses the mutex after the state transition (col. 9 lines 26-48, "If the synchronization condition is satisfied ['triggered'] in block 84, then a determination is made as to whether the mutex associated with this synchronization control point has been previously set by the mutex handler", wherein the thread only operates on the mutex if the synchronization condition has been satisfied).

Allowable Subject Matter

8. Claims 2-4, 17-22, and 28-29 are objected to as being dependent upon rejected base claims, but would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

9. The following is a statement of reasons for the indication of allowable subject matter: Claims 2, 17, and 28 recite limitations pertaining to particular state transitions using the transitional phrase "consisting of". As this is a closed-ended limitation requiring only the recited elements, it significantly limits what is claimed. In view of this particular limitation, the prior art does not disclose or reasonably suggest the set of state transitions claimed. For example, Browning discloses a thread undergoing state transitions, but does not disclose or suggest a state transition between operational states of a computer, processor, or process. Other references are limited in the state transitions disclosed in a similar fashion. That is, the prior art does not disclose or reasonably suggest the claimed set of state transitions in a closed-ended manner.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Syed J Ali whose telephone number is (703) 305-8106. The examiner can normally be reached on Mon-Fri 8-5:30, 2nd Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai T An can be reached on (703) 305-9678. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Syed Ali
January 29, 2004

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